



*National Aeronautics and Space Administration
Goddard Earth Science
Data Information and Services Center (GES DISC)*

README Document for the Nimbus-5 Infrared Temperature Profile Radiometer (ITPR) Level 1 Calibrated Radiance Data

ITPRN5L1

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1. Introduction

This document provides basic information on using the Nimbus-5 Infrared Temperature Profile Radiometer (ITPR) Level-1 Calibrated Radiances data product.

1.1 Data Product Description

The Nimbus-5 Infrared Temperature Profile Radiometer (ITPR) Level-1 Calibrated Radiances data product contains radiances at 7 infrared spectral regions (2683.0, 899.0, 747.0, 713.8, 689.5, 668.3, and 507.4 cm^{-1}) in a single binary data file. Due to problems with the instrument, data are available in three time periods from 14 February 1975 to 1 March 1975 covering East Asia, from 10 May 1976 to 4 June 1976 covering the United States and the Gulf of Mexico, and from 1 September 1976 to 30 September 1976 covering southern Australia and New Zealand. The principal investigators for the ITPR experiment was William L. Smith from NOAA.

This product was previously available from the NASA National Space Science Data Center (NSSDC) under the name Infrared Temperature Profile Radiance Observations with the identifier ESAD-00042 (old id 72-097A-01A).

1.1.1 The Infrared Temperature Profile Radiometer

The objective of the Nimbus-5 Infrared Temperature Profile Radiometer (ITPR) experiment was to describe the three dimensional temperature field within the earth's atmosphere. The radiometer measured radiances in seven infrared regions: four in the 15-micrometer CO₂ band, one interval in the water vapor rotational band near 20 micrometers and two spectral intervals in the atmospheric window regions near 3.7 and 11 micrometers. The instrument scan sequence consists of three separate grid matrices, each matrix consisting of 10 scan lines with 14 scenes per scan. The first grid matrix is 35.1° to 11.7° to the right of the subsatellite track as viewed from the spacecraft and spatial dimensions of 600 km by 357 km. The second or central grid matrix is 11.7° either side of nadir with spatial dimensions of 500 km x 357 km. The last grid matrix is located to the left of the subsatellite track with the same distance and grid dimensions as the first. Spatial resolution for an ITPR FOV scene is 32 km².

Because of the erratic behavior of the scan mechanism which developed shortly after launch, the instrument operated only in the nadir mode except for brief periods. Data are available for the time period from 1975-02-14 to 1976-09-30.

1.1.2 Nimbus-5 Overview

The Nimbus 5 satellite was successfully launched on December 11, 1972. The primary experiments included: (1) a Temperature-Humidity Infrared Radiometer (THIR) for measuring day and night surface and cloud top temperatures, as well as the water vapor content of the upper atmosphere, (2) an Electrically Scanning Microwave Radiometer (ESMR) for mapping the microwave radiation from the Earth's surface and atmosphere, (3) an Infrared Temperature Profile Radiometer (ITPR) for obtaining vertical profiles of temperature and moisture, (4) the Nimbus-E Microwave Spectrometer (NEMS) for determining tropospheric temperature profiles, atmospheric water vapor abundances, and cloud liquid water contents, (5) a Selective Chopper Radiometer (SCR) for observing the global temperature structure of the atmosphere, and (6) a Surface Composition Mapping Radiometer (SCMR) for measuring the differences in the thermal emission characteristics of the Earth's surface.

The orbit of the satellite can be characterized by the following:

- circular orbit at 1100 km
- inclination of 99.9 degrees
- period of an orbit is about 107.2 minutes
- orbits cross the equator at 26 degrees of longitude separation
- sun-synchronous

1.2 Algorithm Background

The Nimbus-5 ITPR data were generated from the spacecraft telemetry, attitude and orbital data. The data were originally processed on IBM 360 computers using a 16-bit words, and copied to 1600 bpi 9-track tapes for archival. Further information on the ITPR instrument and data processing can be found in the Nimbus-5 Users' Guide Section 5.

1.3 Data Disclaimer

The data should be used with care and one should first read the Nimbus-5 User's Guide, Section 5 describing the ITPR experiment. Users should cite this data product in their research:

Smith, William L. (2020), ITPR/Nimbus-5 Level 1 Calibrated Radiances V001, Greenbelt, MD, USA, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed: **[Data Access Date]**, <https://doi.org/10.5067/0V5I84N0OKTY>

2. Data Organization

The Nimbus-5 Infrared Temperature Profile Radiometer Level-1 Calibrated Radiances spans the time period from February 14, 1975 to September 30, 1976. A file contains data from the entire mission.

2.1 File Naming Convention

The data product files are named according to the following convention:

<Platform>-<Instrument>_<Level>_<DateTime>_<TapeNumber>.<Suffix>, where

- o Platform = name of the platform or satellite (Nimbus5)
- o Instrument = name of the instrument and product (ITPR)
- o Level = process level (L1)
- o Date = Data start date in format <YYYY>m<MMDD> where
 - 1. YYYY = 4 digit year (1978 - 1979)
 - 2. MM = 2 digit month (01 - 12)
 - 3. DD = 2 digit day of month (01 - 31)
 - 4. hh = 2 digit hour of day (00 - 23)
 - 5. mm = 2 digit minute of hour (00 - 59)
 - 6. ss = 2 digit second of minute (00 - 59)
- o TapeNumber = 3 digit number of tape (preceded by 'DR' - primary or 'DS' - backup)
- o Suffix = the file format (always TAP, indicating tape binary data)

File name example: Nimbus5-ITPR_L1_1975m0214t022355_DS160.TAP

2.2 File Format and Structure

The data are stored as they were originally written in IBM binary (big-endian) record oriented structured files. The files were written on the original 1600 bpi 9-track tapes using a blocked FORTRAN format. There is just one file on a tape (i.e. there is no tape header file). The file on the tape contains a set of data records with a FORTRAN record size word, the record block, and a FORTRAN record trailing size word.

The entire mission are written as a single file on the tape. Each data record is 2828 bytes in size. Because the tape has just one file on it, the tape will end with a double End-of-File word. Each data record contains all measurements for a 10 x 14 grid matrix. Data are written in big-endian 16-bit words. For the contents and layout of the documentation, see section 3.1. During data recovery there were two tapes, each containing a single file. The primary tape is designated with a DR, while the backup tape is designated with a DS. The DR and DS tape files are identical, except the DS tape file contains two records not found on the DR tape. Hence the DS tape file represents the complete record of the ITPR Level 1 data collection and is archived at the GES DISC.

2.3 Key Science Data Fields

The primary science data field in the ITPR level 1 files are the IR radiances.

Figure 1: Typical data coverage for a Nimbus-5 ITPR Level 1 data file showing radiances at 507.4 cm⁻¹ for the three 10x14 grid matrices on 12 May 1976. The red line shows the sub-satellite track.

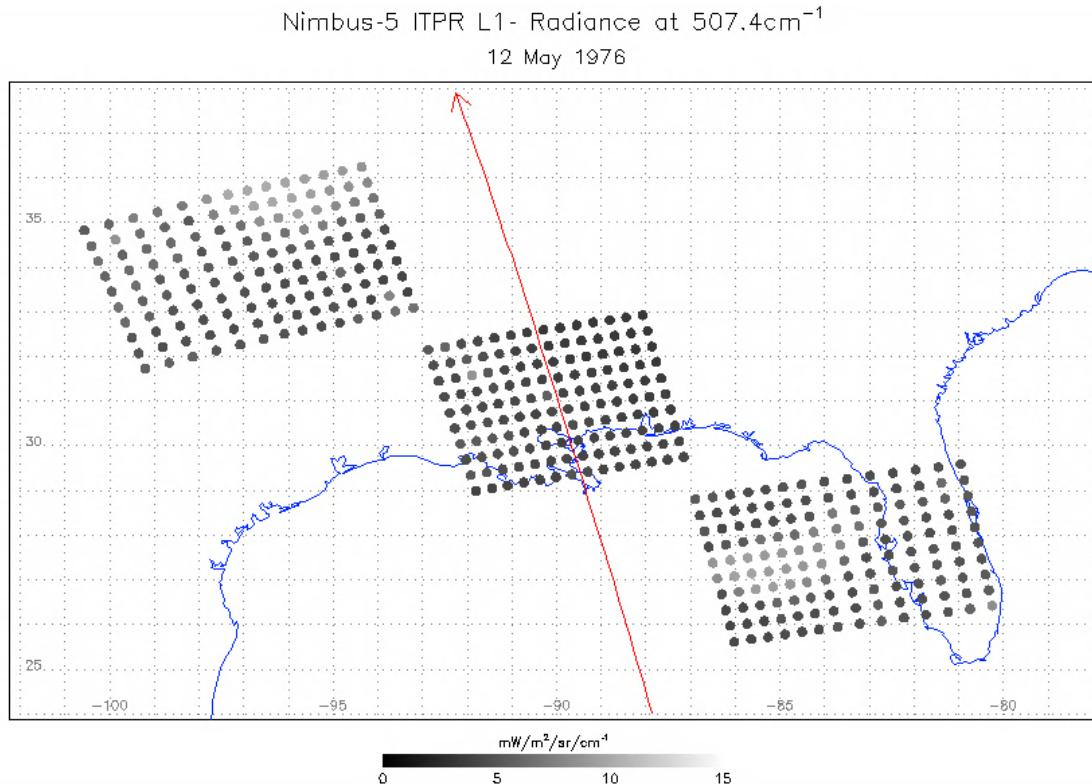
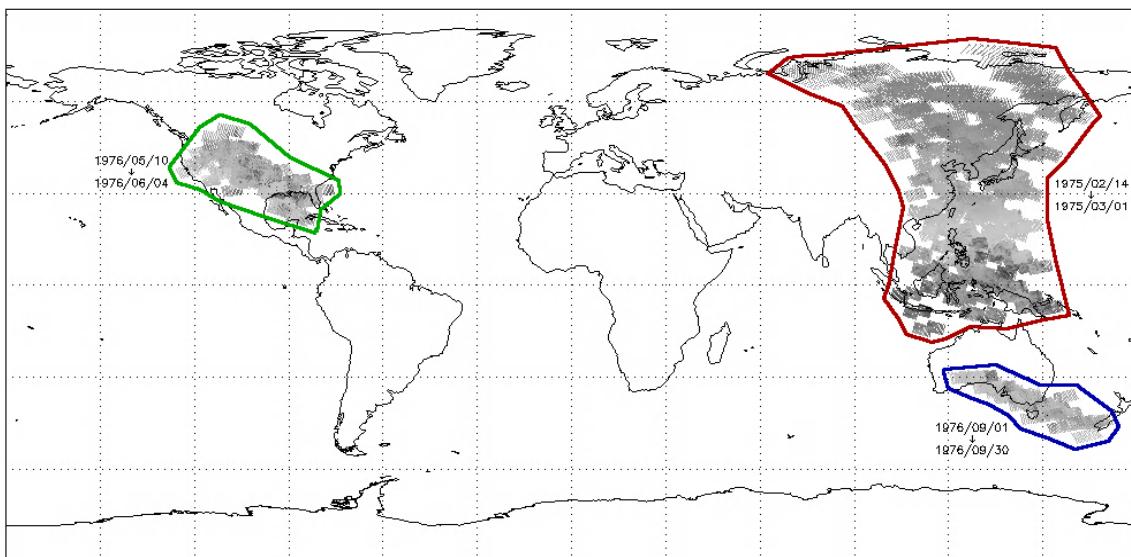


Figure 2: Data coverage for the entire Nimbus-5 ITPR Level 1 product



3. Data Contents

The granularity for the ITPR data is the entire mission with daily resolution.

3.1 Data Records

The Nimbus-5 User's Guide only briefly describes the layout of the file format. Refer instead to the single page "Format of Stacked ITPR Scan Data" document for a fuller description.

The original tape contained the entire mission worth of data in a single file. All data records are 2828 bytes in size. Data are written as big-endian 16-bit words, except the first 8 bytes are two 4-byte big-endian words, listing the number of bytes from the point forward. Then the data record follows the "Format of Stacked ITPR Scan Data" document. Data records 1 through 485 contain daytime and nighttime data for the time period from February 14, 1975 to 1 March 1, 1975, data records 486 through 607 contain daytime and nighttime data for the time period from May 10, 1976 to June 4, 1976, and data records 608 through 681 contain just daytime data for the time period from September 1, 1976 to September 30, 1976. This product typically has three grid matrices for a day (as shown above in Figure 1 in Section 2.3).

Table 3-1 ITPR Data Record

16-bit Word	Field Name	Units	Size	Comments
1-2	Record Length (in bytes)	-	1	(4 byte integer)
3-4	Remaining Record Length (in bytes)	-	1	(4 byte integer)
5	YYMM (year x 100 + month)	-	1	(at line 6, fov 1)
6	DDHH (day x 100 + hour)	-	1	(at line 6, fov 1)
7	MMSS (minute x 100 + second)	-	1	(at line 6 fov 1)
8	Day of Year	-	1	
9-10	Orbit Number (Playback)	-	1	(4 byte integer)
11	Latitude (deg x 100)	deg	1	(-90 to +90)
12	Longitude (deg x 100)	deg	1	(-180 to +180)
13	Local Zenith (deg x 100)	deg	1	(right of subsatellite track)
14 - 20	Radiances	mW/m ² /sr/cm ⁻¹	7	Ch. 1 x 1000 Ch. 2-7 x 100
Words 11 - 20 are FOV 1, line 1. Repeats for FOV 2 - 14, line 1, then FOV 1-14 line 2, etc, for a 14 FOV x 10 line grid				
1411 - 1414	Zero Fill	-	4	Set to zero

3.2 Metadata

The metadata are contained in a separate XML formatted file having the same name as the data file with .xml appended to it.

Table 3-2: Metadata attributes associated with the data file.

Name	Description
LongName	Long name of the data product.
ShortName	Short name of the data product.
VersionID	Product or collection version.
GranuleID	Granule identifier, i.e. the name of the file.
Format	File format of the data file.
CheckSumType	Type of checksum used.
CheckSumValue	The value of the calculated checksum.
SizeBytesDataGranule	Size of the file or granule in bytes.
InsertDateTime	Date and time when the granule was inserted into the archive. The format for date is YYYY-MM-DD and time is hh-mm-ss.
ProductionDateTime	Date and time the file was produced in format YYYY-MM-DDThh:mm:ss.ssssssZ
RangeBeginningDate	Begin date when the data was collected in YYYY-MM-DD format.
RangeBeginningTime	Begin time of the date when the data was collected in hh-mm-ss format.
RangeEndingDate	End date when the data was collected in YYYY-MM-DD format.
RangeEndingTime	End time of the date when the data was collected in hh-mm-ss format.
PlatformShortName	Short name or acronym of the platform or satellite
InstrumentShortName	Short name or acronym of the instrument
SensorShortName	Short name or acronym of the sensor
WestBoundingCoordinate	The westernmost longitude of the bounding rectangle(-180.0 to +180.0)
NorthBoundingCoordinate	The northernmost latitude of the bounding rectangle(-90.0 to +90.0)
EastBoundingCoordinate	The easternmost longitude of the bounding rectangle(-180.0 to +180.0)
SouthBoundingCoordinate	The southernmost latitude of the bounding rectangle(-90.0 to +90.0)
ElapsedMinTime	Duration in minutes of data collected.

4. Reading the Data

The data are written in a binary record-oriented format. Using the record format specification in the section above, users can write software to read the data files. Please note that the data were originally written using a big-endian format, therefore users on little-endian machines will need to swap bytes for the words.

A sample FORTRAN program is included in the Appendix section which will read and print the the data contents. Additionally a FORTRAN function is included to perform byte swapping.

5. Data Services

5.1 GES DISC Search

The GES DISC provides a keyword, spatial, temporal and advanced (event) searches through its unified search and download interface:

<https://disc.gsfc.nasa.gov/>

5.2 Documentation

The data product landing pages provide information about these data products, as well as links to download the data files and relevant documentation:

https://disc.gsfc.nasa.gov/datacollection/ITPRN5L1_001.html

5.3 Direct Download

These data products are available for users to download directly using HTTPS:

https://acdsc.gesdisc.eosdis.nasa.gov/data/Nimbus5_ITPR_Level1/ITPRN5L1.001/

6. More Information

6.1 Contact Information

Name: GES DISC Help Desk

URL: <https://disc.gsfc.nasa.gov/>

E-mail: gsfc-help-disc@lists.nasa.gov

Phone: 301-614-5224

Fax: 301-614-5228

Address: Goddard Earth Sciences Data and Information Services Center

Attn: Help Desk

Code 610.2

NASA Goddard Space Flight Center

Greenbelt, MD 20771, USA

6.2 References

"The Nimbus-5 User's Guide - Section 5 The Infrared Temperature Profile Radiometer (ITPR) Experiment", NASA Goddard Space Flight Center, November 1972, Pages 107-130

"Format of Stacked ITPR Scan Data", 1 page document

7. Appendices

Acknowledgments

The Nimbus data recovery task at the GES DISC is funded by NASA's Earth Science Data and Information System program.

Acronyms

EOS: Earth Observing System

ESDIS: Earth Science and Data Information System

GES DISC: Goddard Earth Sciences Data and Information Services Center

GSFC: Goddard Space Flight Center

L1 Level-1 Gridded Data

ITPR: Infrared Temperature Profile Radiometer

NASA: National Aeronautics and Space Administration

QA: Quality Assessment

UT: Universal Time

FORTRAN Code

```
C-----  
C ^NAME: READ_ITPR  
C   This program will read both the Nimbus 5 ITPR Level 1 Calibrated  
C   Radiances data files.  
C  
C   The files contain data records of size 2828 bytes. This program will  
C   print the contents of every data record.  
C  
C ^MAJOR VARIABLES:  
C     FNAME - name of input file  
C     BUFF  - buffer for data record  
C     TEMP   - buffer for holding temporary 4-byte word  
C     WORD   - integer 4-byte word  
C     IBLKSZ - size of record block in bytes  
C     IOS    - I/O status number  
C  
C ^NOTES:  
C   Compile: gfortran -o READ_ITPR.EXE READ_ITPR.FOR  
C  
C ^ORGANIZATION: NASA/GSFC, Code 610.2  
C  
C ^AUTHOR: James Johnson  
C  
C ^ADDRESS: james.johnson@nasa.gov  
C  
C ^CREATED: Dec. 4, 2020  
C-----  
  
      CHARACTER      FNAME*256      ! Filename  
      CHARACTER      BUFF(21484)    ! Buffer for data record block  
      INTEGER*4      IBLKSZ       ! Size of records  
      INTEGER*4      IWORD         ! 4-byte word  
      INTEGER*2      RECTYP        ! Record type  
      INTEGER*2      I2SWAP        ! Function swaps short ints  
      CHARACTER      TEMP(4)       ! Buffer to hold 4-byte word  
      EQUIVALENCE    (TEMP,IWORD)  
  
C Get the name of the input data file to read  
      WRITE (0, *) , 'Enter the name of the input file:'  
      READ (5,'(A)') FNAME  
      PRINT '("FILE = ",A)', FNAME  
  
C Open the specified input file  
      OPEN (UNIT=1, FILE=FNAME, STATUS='OLD', ACCESS='DIRECT',  
      &           FORM='UNFORMATTED', RECL=1, ERR=99, IOSTAT=IOS)  
  
C Initialize N (record number) and IOFF (byte offset in file)  
      N=0  
      IOFF=0  
  
C Loop through the file reading all records in file  
      5 DO
```

```

C Read the first 4-byte word or record size header
10  DO I=1,4
    READ (1, REC=IOFF+I, IOSTAT=IOS, ERR=90) TEMP(I)
    END DO
    IBLKSZ = IWORD
    IOFF=IOFF+(I-1)

C End-of-File (EOF) mark, exit loop
    IF (IBLKSZ .EQ. 0) EXIT

C Next read the block of data
20  DO I=1,IBLKSZ
    READ (1, REC=IOFF+I, IOSTAT=IOS) BUFF(I)
    IF (IOS .NE. 0) THEN
        PRINT '("ERROR: BUFF ",I4,X,I4,", IOSTAT: ",I6)', N,I-1,IOS
        STOP
    END IF
    END DO
    IOFF=IOFF+(I-1)
    N=N+1

    PRINT '("==== REC ",I3," =====")', N
    CALL PRDREC(IBLKSZ,BUFF)

C Finally read the last 4-byte word (should match first record size)
30  DO I=1,4
    READ (1, REC=IOFF+I, IOSTAT=IOS, ERR=90) TEMP(I)
    END DO
    IF (IBLKSZ .NE. IWORD) THEN
        PRINT '("WARNING: IBLKSZ ",I10," != ",I10)', IBLKSZ, IWORD
    END IF
    IOFF=IOFF+(I-1)

    END DO

C Close the input file
90 CLOSE(1)
STOP

99 PRINT '("ERROR: OPEN FILE, IOSTAT: ",I6)', IOS

100 STOP
END

C-----
C      This Subroutine will print the Data Records
C-----
SUBROUTINE PRDREC(IBLKSZ,BUFF)

CHARACTER      BUFF(2828)                      ! Buffer for record block
INTEGER*2       IWORD(1414)                     ! Array of short ints
INTEGER*2       I2SWAP                           ! Function swaps short ints

DO I = 1,1414
    IWORD(I) = I2SWAP(BUFF(2*I-1:2*I))
END DO

```

```

PRINT '("RECLEN =",X,I8)', IWORD(1)+ISHFT(INT(IWORD(2)),16)
PRINT '("REMLEN =",X,I8)', IWORD(3)+ISHFT(INT(IWORD(4)),16)
PRINT '("YYMM    =",X,I8)', IWORD(5)
PRINT '("DDHH    =",X,I8)', IWORD(6)
PRINT '("MSS     =",X,I8)', IWORD(7)
PRINT '("DAY     =",X,I8)', IWORD(8)
PRINT '("ORBIT   =",X,I8)', IWORD(9)+ISHFT(INT(IWORD(10)),16)
DO I = 1,10
  DO J = 1,14
    K=10*(14*(I-1)+(J-1))                                ! FOV Block Offset
    PRINT '("-----")'
    PRINT '("LINE: ",I2,", FOV: ",I2)', I, J
    PRINT '("LAT     =",X,F8.3)', IWORD(K+11)/100.
    PRINT '("LON     =",X,F8.3)', IWORD(K+12)/100.
    PRINT '("ZEN     =",X,F8.3)', IWORD(K+13)/100.
    PRINT '("RAD     =",X,F8.4,6(X,F8.3))', IWORD(K+14)/1000.,
    +                                              IWORD(K+15:K+20)/100.
  +
  END DO
END DO
C   PRINT '("SPARE   =",4(X,I8))', IWORD(1410:1414)

RETURN
END

C-----
C ^FUNCTION: I2SWAP
C
C   This function will swap the bytes of a 2-byte word
C-----

INTEGER*2 FUNCTION I2SWAP(BUFF)

CHARACTER          BUFF(2)           ! Input data buffer
CHARACTER          TEMP(2)           ! Output swapped buffer
INTEGER*2          I2BUFF
EQUIVALENCE        (TEMP, I2BUFF)

TEMP(1) = BUFF(2)
TEMP(2) = BUFF(1)
I2SWAP = I2BUFF

RETURN
END

```